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Depression and change in occupational functioning in type 2 diabetes

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Abstract

Background: The effect of depression on both employment and productivity in type 2 diabetes (T2D) is poorly understood.

Aims: We tested whether depressive symptoms at diagnosis of T2D are associated with change in employment status and productivity over 2-year follow-up.

Methods: In a prospective analysis of working-age (18-63 years) people with newly diagnosed T2D recruited from primary care, we tested the association between depressive symptoms at diagnosis of T2D (baseline) and employment rates over 2 years. Using the Patient Health Questionnaire-9, depressive symptoms were measured categorically (depression caseness score ≥ 10) and continuously. In those employed, we measured changes in presenteeism and absenteeism using the World Health Organization (WHO) Health and Work Performance Questionnaire in univariate and multivariate models respectively including and excluding part-time workers.

Results: Of 1202 people aged 18-63 at baseline, 982 (82%) provided employment information; the mean age was 50.3 (SD 8.1) years, 44% were female, 59% of non-white ethnicity and 16% had depression. After adjustment for age, sex, ethnicity, socioeconomic status, diabetes control and depression treatment, depression caseness was associated with worsening unemployment over 2 years only in full-time workers (OR 0.43 (95% C.I. 0.20, 0.96), $p < 0.05$). In those employed full-time or part-time, total depressive symptoms were associated with worsening presenteeism over 2 years after full adjustment ($\beta = -2.63$ (95% C.I. -4.81, -0.45), $p < 0.05$), despite no association with worsening absenteeism.

Conclusions: In newly diagnosed T2D, depressive symptoms demonstrate an association with worsening employment rate and decline in work productivity over 2-year follow-up.

Key words: Depressive symptoms; type 2 diabetes; longitudinal; cohort; employment; presenteeism.

Introduction

Depressive symptoms and type 2 diabetes (T2D) are associated with significant costs for the individual and society. For depressive symptoms, the typical age of onset is in the third decade [1] at a time when people are typically developing economic independence. Depressive symptoms usually have a chronic or fluctuating course [2], are associated with reduced work performance and higher absenteeism, and account for £6 billion of lost earnings in the UK per annum [3-5]. T2D is typically diagnosed in the fourth and fifth decades in those of African/Caribbean/Asian and white ethnicity respectively [6, 7]. T2D is associated with reduced employment and reduced productivity in those at work [8, 9]. The current indirect costs associated with T2D are estimated at £13 billion in the UK per annum, including £2.9 billion lost in presenteeism for T2D alone [10]. As the age of onset of T2D continues to decrease [7], its effects on productivity at work are increasingly pertinent.

Despite advances in understanding of the occupational effects of depressive symptoms and T2D, few studies have tested the occupational effects of their comorbidity [11]. In a large cross-sectional survey of US diabetes patients, comorbid depressive symptoms were associated with increased unemployment and reduced work performance [12]. In another US survey, comorbid depressive symptoms were associated with 50-75% increases in health service costs [13]. However, these studies had important limitations, including their mail survey design, heterogeneity of diabetes type and duration, and their cross-sectional design. In people with T2D, no previous research has examined the additional prospective effect of comorbid depressive symptoms on employment and work productivity. This is important because depressive symptoms are twice as common in people with T2D [14], predict poor biomedical outcomes [15, 16], and can be treated effectively [17]. Moreover, people with comorbid depressive symptoms and T2D tend to be younger than those with T2D alone [18] and therefore have a longer potential working life. Early recognition and treatment of depressive symptoms in early T2D could therefore improve employment rates and reduce decline in productivity.

In a multi-ethnic cohort of patients with newly diagnosed T2D, we tested whether depressive symptoms were more likely to be associated with lower employment status and reduced work performance over 2-year follow-up.

Methods

The South London Diabetes (SOUL-D) study is a population-based cohort of adults with newly diagnosed T2D followed up for 2 years. All GP surgeries in the south London boroughs of Lambeth, Southwark and Lewisham were invited to participate [7]. Ethical approval was granted by King's College Hospital Research Ethics Committee (reference 08/H0808/1), including for this occupational sub-study, and by Lambeth, Southwark, and Lewisham Primary Care Trusts (reference RDLSLB 410). All participants provided written informed consent [7, 18]. Recruitment took place between 2008-2012 and follow-up between 2010-2014. Detailed recruitment methods are reported elsewhere [7, 19]. Participating surgeries invited all people with a diagnosis of T2D within the last 6 months to participate. The current analysis, planned at the outset of SOUL-D, was based on those aged 18-63 years, reflecting typical working age whilst accounting for 2-year follow up. Diagnosis of T2D followed World Health Organization (WHO) guidelines [7]. The GP records search excluded patients with diabetes duration longer than 6 months; non T2D; diagnosis of a dementia, primary psychotic disorder or bipolar disorder with psychotic symptoms; terminal illness; and advanced diabetes complications (registered blind, requiring dialysis, or previous above-the-knee amputation). Participants were further excluded if they were non-fluent in verbal English or had temporary residence and/or residence outside the catchment area.

The independent variable was depressive symptoms measured using the 9-item self-report Patient Health Questionnaire-9 (PHQ-9), which has been validated for use in people with T2D [20-21]. The questionnaire was administered within 6 months of diagnosis of T2D for all participants. We used two independent variables: i) caseness for depression, defined as PHQ-9 score ≥ 10 [20, 22]; and ii) total PHQ-9 score as a continuous measure of depressive symptoms. For participants with less than 20% missing PHQ-9 data, we used case mean substitution to impute missing values [23].

Using the WHO Health and Work Performance Questionnaire (HPQ) [24], we selected three outcomes at 2-year follow-up: i) Proportion in employment, namely, ‘have you worked in the past 28 days?’ in the HPQ, collected for all adults aged 18-63 in the sample; ii) absolute absenteeism score (work hours lost per 28 days), measured in the subset in employment. To calculate this score, participants were firstly asked, “How many hours does your employer expect you to work in a typical 7-day week? If it varies, estimate the average. If you are self-employed, estimate the number of hours you would consider a full work week. If you have more than one job, combine total number of hours for all jobs.” Participants were then asked, “About how many hours altogether did you work in the past 7 days? If you have more than one job, report the combined total number of hours for all jobs. If you did not work at all in the past 7 days, enter “0”.” Remote working was also included. Absolute absenteeism in the past 28 days was calculated by the following formula: $4 \times \text{expected hours} - 4 \times \text{actual hours worked}$. Higher scores represent a higher amount of absenteeism and productivity loss. iii) Absolute presenteeism score (actual performance as a percentage of possible performance [24]), measured only in the subset in employment. Participants were asked, “On a scale from 0 to 10 where 0 is the worst job performance anyone could have at your job and 10 is the performance of a top worker, how would you rate the usual performance of most workers in a job similar to yours?”. Participants were then asked, “Using the same 0-to-10 scale, how would you rate your overall performance on the days you worked during the past 7 days?”. The second score was taken and multiplied by 10 to give the absolute presenteeism score from 0 (total lack of performance) to 100 (no loss of performance).

Covariates were age; sex; self-reported ethnicity based on 2001 UK Census categories; socio-economic status based on main current or previous occupation, categorized according to the National Statistics Socio-Economic Classification (NS-SEC) 8-class analytical version collapsed to a 3-class version [25]; glycaemic control measured by baseline HbA1c (mmol/mol); severity of diabetes, classed as any macrovascular or microvascular complication at diagnosis; and any treatment for depression (licensed antidepressant or psychological therapy) received during the study. Full details

of data collection methods for covariates are described elsewhere [7]. Baseline data were stratified by depression caseness at baseline. Analyses were conducted using Student's t-test for continuous data or chi-squared statistics for categorical data or using Mann Whitney U test for skewed continuous data. All analyses were conducted in IBM SPSS 24.0 [26]. The proportion employed at 2 years was compared between people with- and without caseness for depression at baseline (Model 1, unadjusted). For 2-year absenteeism and presenteeism scores, unadjusted analyses were carried out using bootstrapped independent t-tests to compare scores between those with- and without depression at baseline (Model 1, unadjusted). These analyses were then repeated using continuous PHQ-9 score (natural log-transformed) as the independent variable. For employment status at 2 years, we used logistic regression with inclusion of the covariates above (Model 2), as well as adjusting for baseline employment status to test for worsening employment rate over time. For the association between depressive symptoms and absenteeism and presenteeism at 2 years, we used a linear bootstrap regression model with 1000 re-samples to adjust for the covariates above and for baseline absenteeism and presenteeism scores respectively (Model 2). These analyses were then repeated using continuous PHQ-9 score (natural log-transformed) as the independent variable. In Model 3, analyses were further adjusted for the use of any treatment for depression during the study. The core analyses included both full-time and part-time workers. However, as reduction to part-time working could be a pre-existing consequence of depressive symptoms, we repeated the fully adjusted models after the exclusion of part-time workers from the analysis (Model 4).

Results

Of 1202 people aged 18-63 years at baseline, 982 (82%) provided HPQ information and therefore were included in the analysis. Mean age was 50.3 years (SD 8.1), 44% were female, 46% of African/Caribbean ethnicity, and mean HbA1c was 54.7 (17.0) mmol/mol. At baseline, compared with those who provided HPQ information, those with missing HPQ information (n=238) were more likely to have caseness for depression (26% vs 16%, $p<0.001$), were older (52.2 vs 50.3 years $p<0.01$) and were more likely to be female (51% vs 43.8%, $p<0.05$). There was no significant difference in ethnicity, socioeconomic status, HbA1c or diabetes severity. All 982 patients provided PHQ-9 data.

At baseline, 664 participants (68%) reported being currently employed. Employment was significantly lower in people with caseness for depression than non-depressed controls (51% vs 71%, $p<0.001$). Compared to people in full-time employment, those with caseness for depression had a higher proportion of people on sick leave or medically retired (Table 1). Of the 664 people in employment at baseline, 517 (78%) responded to the absenteeism questions and 647 participants (97%) to presenteeism questions at baseline. People with depressive symptoms reported significantly greater loss of working hours at baseline (Table 1). People with depression caseness also reported working at lower performance compared to non-depressed participants (Table 1).

[Table 1 here](#)

At 2-year follow-up, 626 (64%) of 982 participants provided data on current employment. Compared with respondents, those who were lost to follow-up were marginally younger (mean age 49.3 vs. 50.9 years, $p<0.01$), more likely to be African/Caribbean (54% vs. 41%, $p<0.001$ compared to white ethnicity), had worse glycaemic control (57.1 vs 53.4 mmol/mol, $p<0.01$) and had lower socioeconomic status (SES 3=46% vs. 38%, $p<0.05$ compared to SES 1), but showed no differences in baseline caseness for depression, sex, presence of diabetes complications, or proportion in employment at baseline. At 2 years, the overall employment level was comparable to baseline (66% vs 68%). After adjustment for covariates, neither caseness for depression nor total PHQ-9 score were associated with reduced employment at 2 years (Table 2, Model 2), nor after further adjustment for antidepressant treatment (Table 2, Model 3). However, stratifying by full-time versus part-time workers (Model 4), depression caseness was associated with worsening employment rate after 2 years in the former only (Table 2). Of those who reported working at 2 years ($n=410$), 353 (86%) participants provided absenteeism scores and 397 (97%) participants provided presenteeism scores. Baseline depression caseness was not associated with differences in 2-year absenteeism or presenteeism scores. Whereas neither categorical nor continuous depression measures were associated with increased absenteeism at 2 years, higher PHQ-9 score (continuous) was associated with worsening presenteeism at 2-year follow-up (Model 2), an association that persisted after further adjustment for antidepressant treatment (Model 3). After the exclusion of part-time workers from the

analysis (Model 4), higher PHQ-9 score remained similarly associated with worsening presenteeism after full adjustment (Table 2).

[Table 2 here](#)

Discussion

In this prospective cohort study of working age adults with newly diagnosed T2D, depression at the time of diabetes diagnosis was associated with worsening unemployment at 2-year follow-up in those working full-time but not in part-time workers. Whereas elevated depressive symptoms did not affect levels of absenteeism in those participants in work, depressive symptoms were significantly associated with a decline in work performance assessed at 2-year follow-up, as estimated using absolute presenteeism. This remained robust to potential confounding by a range of sociodemographic and biomedical covariates and remained significant after exclusion of part-time workers. Adjusting for depression treatment did not significantly affect any of the results. Previous cross-sectional studies have identified an additive burden of diabetes and depressive symptoms on productivity [8, 27], yet prospective research testing the effects of comorbid depressive symptoms on occupational function in people with diabetes has been scarce. Our study is the first to observe that depressive symptoms in the early stages of T2D are associated with a significant decline in employment rate and in work performance over time. By recruiting a cohort with newly diagnosed T2D of whom over 40% were of African/Caribbean ethnicity, our study maximized the number of working-age adults in its sample and minimized disabling diabetes complications as a potential confounder.

Our study was limited by 36% missing employment data at 2 years, although attrition did not differ significantly in proportion with depression at baseline. Depressive symptoms were measured using a self-report questionnaire, which will have over-estimated prevalence compared with diagnostic interview [21]. Further, patients with depressive symptoms could have a more negative view of their occupational performance, which could adversely affect self-appraisal of their productivity. Some people captured as having depression in our analysis could have been experiencing a transient adjustment reaction to the diagnosis of diabetes. However, we have previously reported a constant

prevalence of depression during the first 2 years of diabetes [19]. We assessed absenteeism and presenteeism according to estimates for the previous 7 days (multiplied by 4), rather than an overall 28-day time frame. Although our approach may increase the risk of recent peaks or troughs being amplified, the HPQ protocol acknowledges that the 7-day measure is easier for participants to recall.

A previous systematic review found that the number of days lost annually was between 5.4 and 18.1 days for employees with diabetes, between 3.4 and 8.7 for those without diabetes and 78.5 days for employees with diabetes and depressive symptoms [8]. Using the same assumption of 40 hours per week over 50 weeks per year, the absenteeism in our sample equated to 63.8 days lost per year in people with depressive symptoms and 31.9 days lost per year in those without depressive symptoms. Both compare unfavourably with recent UK estimates averaging 4.3 days lost per year per worker [28]. Although these findings require confirmation against a non-diabetes control sample from a similar urban population, they suggest that people with T2D have lower productivity compared to the general population [28]. Other than the need to attend additional medical appointments and the likelihood of medical comorbidities, this high absenteeism in people with T2D could be partly explained by the effects of diabetes complications, which were present in 35% of our sample even at diagnosis of T2D.

Our findings suggest that elevated depressive symptoms have a negative effect on both employment and work performance manifesting itself early in the diagnosis of T2D. The association between depression and unemployment was observed only when depression was defined categorically as a score of 10 or more on the PHQ-9. This suggests that depression must reach a severity threshold before effects on employment are most apparent. We further found that depression was only associated with worsening employment in full-time workers. One explanation is that depression prior to entering the study could have already contributed to reduction in working hours. By contrast to employment, the association between depressive symptoms and presenteeism was observed when the PHQ-9 was analysed as a continuous scale. This suggests that subthreshold depressive symptoms i.e. those below the cut-off to define depression caseness may impact on occupational performance.

The findings were not affected by adjustment for depression treatment. One explanation is that people offered treatment have the most severe depression, which is itself likely to have the greatest burden on occupational function. Meanwhile, people with subthreshold depressive symptoms are less likely to be offered antidepressant treatment. Promisingly, there is good evidence from previous research that treatment of depression leads to improvement in work performance [29]. The time of diagnosis of T2D thus provides a potential window for screening for depressive symptoms and developing interventions for primary- and secondary prevention of social and economic losses. Productivity losses are further minimized when recognition, structural and attitudinal barriers to treatment are removed [30]. Therefore, parallel qualitative research is also needed to elucidate reasons why these people suffer a decline in work productivity so that interventions and supportive policy can help overcome such potentially reversible barriers.

Key points:**What is already known about this subject:**

- Depressive symptoms are twice as common in people with type 2 diabetes and are associated with reduced quality of life and poor biomedical outcomes
- Patients with comorbid depressive symptoms and type 2 diabetes tend to be younger than those with type 2 diabetes alone and therefore have a longer potential working life
- Although depressive symptoms and type 2 diabetes are respectively associated with reduced employment and productivity, the occupational effect of their comorbidity has not been studied prospectively

What this study adds:

- In a unique multi-ethnic cohort of people with newly diagnosed type 2 diabetes recruited from primary care, our study tests the association between depressive symptoms and change in occupational functioning over 2 years

- For the first time, we show that depressive symptoms in people with type 2 diabetes are associated with both worsening employment rate and decline in presenteeism over time

What impact this may have on practice or policy:

- Timely identification and treatment of depressive symptoms in early type 2 diabetes may provide a window of opportunity to reduce decline in work productivity and produce wider economic benefits

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Competing interests

None declared.

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Table 1: Baseline characteristics of working-age adults in the SOUL-D cohort

Baseline variable	Total n = 982	No depression (PHQ-9 score <10) n = 830	Depression (PHQ-9 score ≥10) n = 152	P value
Mean (SD) age, years	50.3 (8.1)	50.5 (8.2)	49.3 (7.9)	¹ NS
Gender (n%)				
Male	552 (56)	478 (58)	74 (49)	-
Female	430 (44)	352 (42)	78 (51)	² <0.05*
Ethnicity (n%)				
White	407 (41)	347 (42)	60 (40)	-
Black	451 (46)	382 (46)	69 (45)	^{2,3} NS
Asian/other	124 (13)	101 (12)	23 (15)	^{2,3} NS
NS-SEC Classification (3 categories) (%)				
1 (high)	354 (39)	310 (40)	44 (32)	-
2	182 (20)	155 (20)	27 (20)	^{2,4} NS
3 (low)	372 (41)	306 (40)	66 (48)	^{2,4} <0.05*
Mean HbA _{1c} , mmol/mol	54.7 (17)	54.4 (17)	56.1 (17)	¹ NS
(n%) with at least one diabetes complication	287 (35)	233 (34)	54 (42)	² NS
Employment				
n(%) currently employed	664 (68)	586 (71)	78 (51)	-
n(%) currently unemployed	318 (32)	244 (29)	74 (49)	² <0.001***
Employment status (n%)				
Full-time employment	543 (55)	488 (59)	55 (36)	-
Part-time employment	138 (14)	116 (14)	22 (15)	^{2,5} NS
On sick leave	16 (2)	7 (11)	9 (6)	^{2,5} <0.001***
Unemployed	164 (17)	118 (14)	46 (30)	^{2,5} <0.001***
Medically retired	45 (5)	35 (4)	10 (7)	^{2,5} <0.05*
Housewife/ Househusband	33 (3)	28 (3)	5 (3)	^{2,5} NS
Retired	42 (4)	37 (5)	5 (3)	^{2,5} NS
Productivity				
Mean (SD) Absenteeism score (n=517)	22.6 (49.3)	20.4 (47.7)	40.8 (58.0)	¹ <0.01**

Mean (SD) Presenteeism score (n=647)	81.3 (19.8)	82.5 (18.3)	72.2 (27.4)	¹ <0.001*
<p>Data are <i>n</i> (%) or mean (SD) as appropriate.</p> <p>*significant difference p<0.05; **p<0.01; ***p<0.001</p> <p>1. Comparison of means using Student's t-test; 2. Comparison of proportions using chi-square test; 3. Compared to white ethnicity; 4. Compared to NS-SEC class 1; 5. Compared to proportion in full-time employment.</p> <p>Key: N, number; SD, standard deviation; NS, not significant; NS-SEC, National Statistics Socio-Economic Classification 8-class analytical version collapsed to a 3-class version (1=high, 3=low); OR, odds ratio; PHQ-9, Patient Health Questionnaire-9.</p>				

Table 2: Multivariate analyses testing depressive symptoms and associated occupational outcomes in the SOUL-D cohort^a

		Independent variable							
		Caseness for depression (PHQ-9 score ≥10) at baseline				Total PHQ-9 score (natural log-transformed) at baseline			
Dependent variable		Model 1 (unadjusted)	Model 2 ^b	Model 3 ^c	Model 4 ^d	Model 1 (unadjusted)	Model 2 ^b	Model 3 ^c	Model 4 ^d
Employment status at 2 years ^e	OR (95% C.I.) p-value total number	0.37 (0.23, 0.58) p<0.001*** n=626	0.56 (0.28, 1.11) NS n=469	0.56 (0.27, 1.14) NS n=469	0.45 (0.21, 0.96) p<0.05* n=405	0.78 (0.65, 0.92) p<0.01** n=626	1.05 (0.80, 1.36) NS n=469	1.07 (0.81, 1.42) NS n=469	0.97 (0.73, 1.30) NS n=405
Presenteeism score at 2 years ^f	β (95% C.I.) p-value total number	-4.54 (-12.70, 2.58) NS n=365	-2.23 (-8.77, 4.30) NS n=262	-1.47 (-8.46, 5.46) NS n=262	-0.01 (-7.46, 7.45) NS n=213	-4.00 (-5.96, -2.31) p<0.01** n=365	-2.63 (-4.81, -0.45) p<0.05* n=262	-2.37 (-4.42, -0.20) p<0.05* n=262	-2.87 (-5.25, -0.50) p<0.05* n=213
Absenteeism score at 2 years ^f	β (95% C.I.) p-value total number	3.29 (-14.47, 22.72) NS n=329	4.18 (-25.49, 37.83) NS n=193	1.33 (-27.85, 34.15) NS n=193	-10.14 (-44.04, 23.77) NS n=155	3.14 (-3.27, 9.40) NS n=329	3.90 (-4.98, 12.81) NS n=193	2.94 (-5.75, 11.82) NS n=193	1.13 (-8.61, 10.88) NS n=155

a) Only participants aged 18-63 who provided Health and Performance Questionnaire data are included.

b) Multivariable regression model adjusted for age, sex, ethnicity, NSEC social class status, baseline HbA_{1c}, severity of diabetes and the baseline value for the dependent variable of interest (e.g. for 2-year employment status, model is adjusted for baseline employment status)

c) As per Model 2 with further adjustment for any treatment for depression (antidepressant or psychological therapy) received during the study.

d) As per Model 3 but with the exclusion of part-time workers.

e) For the outcome employment status, multivariable logistic regression is used.

f) For outcomes presenteeism and absenteeism, a linear bootstrap model with 1000 re-samples is used.

*significant difference p<0.05; **p<0.01; ***p<0.001

Key: C.I., confidence interval; NS, not significant; NSEC, National Statistics Socio-Economic Classification (NS-SEC) 8-class analytical version collapsed to a 3-class version (1=high, 3=low); OR, odds ratio; PHQ-9, Patient Health Questionnaire-9.